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(दूसरा पुनरीक्षण)

Guide for Core Drilling Observations

(Second Revision)

ICS 93.020

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FOREWORD

This Indian Standard (Second Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Geological Investigation and Subsurface Exploration Sectional Committee had been approved by the Water Resources Division Council.

This standard was first published in 1969 and subsequently revised in 1980. In the first revision provisions had been added for keeping the sludge samples in cases of poor core recovery. Some additional drilling information to be recorded like types of barrels and bits and depth at which in situ tests were done had been included. Standard proforma given in Annex A had been modified by adding more items and indicating the units of various recordings. The present revision has been made to reflect the experience gained in the field since then.

This standard forms a part of a series of complementary standards. Other standards in this series are:

IS No.	*Title*
4078 : 1980	Code of practice for indexing and storage of drill cores (*first revision*)
4464 : 1985	Code of practice for presentation of drilling information and core description in foundation investigation (*first revision*)
6926 : 1996	Diamond core drilling for site investigation for river valley projects — Code of practice (*first revision*)

With the increased number of river valley projects and other major civil engineering works being undertaken in the wake of planned development of the country, a good amount of core drilling (including calyx, diamond and other types of drillings) is being carried out. Each organization handling the individual projects maintains a record of drilling data in its own way. In some cases (especially in the case of small works) it also happens that no record of the drilling data is maintained at all. As drilling is a very costly process, it is of utmost importance that complete observations should be made during a drilling operation. In order to keep a faithful and complete record of the drilling operations, the officer-in-charge of any river valley project should be assisted by competent drilling and core observers/engineering geologists. It is, therefore, necessary that the drilling and core observers/engineering geologists observe and record relevant data that would be subsequently useful in interpretation of drilling data. This standard has, therefore, been prepared to give the necessary guidance in observations to be recorded at the time of drilling operation.

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated, expressing the results of a test or analysis shall be rounded off in accordance with IS 2 : 1960 ‘Rounding off numerical values (*revised*)’. The number of significant places retained in the rounded off value should be the ‘same as that of the specified value in this standard.

Indian Standard

GUIDE FOR CORE DRILLING OBSERVATIONS

(Second Revision)

1 SCOPE

This standard gives guidance in carrying out drilling observations while drilling for investigations of river valley projects. A standard proforma is given for the record of the general observations.

2 REFERENCES

The standards given below contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards.

IS No.	*Title*
4078 : 1980	Code of practice for indexing and storage of drill cores (*first revision*)
5529 (Part 1) : 2013	Code of practice for in-situ permeability test: Part 1 Test in overburden (*second revision*)
5529 (Part 2) : 2006	In-situ permeability tests: Part 2 Tests in bedrock (*second revision*)

3 DRILLING OBSERVATIONS

3.1 Behaviour of Drill Water

3.1.1 The colour of the return drill water should be recorded continuously and the depth at which changes in regard to these characteristics occur. The return water brings with it the cuttings of the strata through which the drilling is in progress and provides information with regard to the lithology and the general nature of the strata through which the drill bit is progressing. For example, drilling through hard and structurally sound quartzite may generally give clean water with only a few particles. Whereas, return drill water thickly laden with cuttings may be recovered while drilling through comparatively soft interbedded shale strata or clay filled seams or shear zones. Excessively mud laden water containing a lot of cuttings may also correlate with poor recovery of core at that depth and indicate probable reason for the core loss.

3.1.2 The depth at which drill water is lost or returned fully or partially should also be recorded as it may indicate the existence of open joints or any other special geological feature, such as cavities and faults which may have caused the loss of water in the drill hole at the specified depths; subsequent recovery of drill water, especially upon placement of casing and/or grouting across the leaky zone, may indicate the extent of the leaky zones.

3.1.3 Where hot water is encountered during drilling, the temperature of the water, depth of occurrence and amount of flow should be recorded.

3.2 Rate of Penetration

3.2.1 The rate of penetration gives indication as to the comparative physical nature of the strata through which the bit is passing. For example, in hard quartzite bands, the rate of penetration is generally slow compared to the progress in shale bands. Rate of penetration shall be determined for each jack length or every 30 cm. The depth through which a uniform rate of penetration was maintained and the depth at which it showed a marked change should be noted as this would help in locating the depth at which the actual change of strata occurred, although, due to the loss of core in the softer formation, it may not be possible to precisely locate its vertical extent from the examination of the core alone.

3.2.2 Any sudden fall of the drill rod and the depth at which such a fall occurs should also be carefully recorded. This may give an indication of the existence of any open seam or cavity in the drilled strata or of any markedly weak or softer zone therein, if the fall of the drill rod is also accompanied by highly muddy return drill water. The type of bit used and condition of the bit whether old or new should be specified.

3.3 Core Loss

3.3.1 The depth at which a core loss might have taken place, as adjudged by the behavior of the drill machine while drilling should be recorded. This will enable the geologist interpreting the observations to give probable reason for the loss. In this connection, blockage of drill bit during drilling and the recovery of re-drilled and rounded core pieces should be recorded in the daily drill report.

3.3.1.1 Poor core recovery may be due to various causes such as, poorly consolidated nature of the rock, presence of highly sheared zones, clay-filled seams, as well as inclination of the hole with respect to the foliation of the rock and even due to the technique of drilling. The length of the drilling should be restricted to 30 cm while drilling through softer formation where there is an apprehension of poor core recovery.

3.3.1.2 Sludge samples often give important clues to adjudge causes for poor core recovery. These samples shall be kept for all runs where poor core recovery is anticipated (*see* IS 4078).

3.3.1.3 Core recovery may be ruined by careless operation by drilling too fast, over drilling a run, dropping core and grinding it or not pulling out the tools when the barrel is jammed and thereby grinding the core. Vibration in the drill string also causes poor core recovery.

3.4 Vibration and Torque

Any heavy vibration or torque noted during the drilling should be recorded together with the depth of drilling at which these phenomena are noticed. Any remedial measures taken and their effect on vibration and torque should also be recorded. The record of vibration and torque should be integrated with the type of formation crossed, nature of core breakage and the amount of core recovered.

3.5 Ground Water Level in the Hole

The ground water level in the drill holes should be recorded every day, both before and after the drilling and any fluctuations in the levels observed therein should be noted. In cases where considerable divergence in the levels is noticed it may be necessary to bail out the water and record the level as recuperated to equilibrium value. This information will give an indication as to the ground water table condition, if this is intercepted by the drill hole. It may also indicate the degree of tightness or otherwise of the rocks drilled through, when studied in conjunction with the pressure percolation test data.

3.6 Other Special Conditions to be Noted

Any other conditions which may be peculiar to individual cases should be noted. Some of the special conditions which are likely to occur are given in **3.6.1** to **3.6.5** (*see* also drilling and core observer's remarks under Annex A).

3.6.1 *Depth at which Hole was Grouted*

The depth at which grouting of the hole had to be done should be recorded for effectively interpreting the foundation conditions under an engineering structure. Grouting of the hole may sometimes be necessary while the drilling is being done through broken strata, as the sides of the hole collapse frequently due to the poor physical condition of the substrata. Also, in those cases where the drill water is continuously being lost and a flushing of the cuttings from the drill hole is not observed, grouting of the hole may have to be resorted to avoid the jamming of the bit inside the hole. In either case, the necessity for grouting is an important indication of the lithological and the physical nature of rock being drilled through. If the hole is grouted or stabilized by using bentonite slurry, this fact should be recorded.

3.6.2 *Artesian Conditions*

Wherever artesian conditions are observed, they should be recorded carefully. As far as possible, accurate observations should be made with regard to the depth, the pressure and the volume of outflow of water from such artesian horizons, by using water meters or by diverting the flow to a measured container. The piezometric head of each horizon as observed at the ground surface at each drilling point should also be noted.

3.6.2.1 The piezometric head should be determined by using a sensitive pressure gauge to the drill pipe or casing. The alternative, but approximate, method of determining the piezometric head by fixing a pipe above the top of the hole as soon as an artesian horizon is encountered and recording the rise of water level in the pipe may also be used. In order to accurately determine the piezometric head of individual artesian horizons pierced by the hole, packers should be fixed at the top and bottom of the horizon in the hole prior to the recording of the piezometric head above the ground surface at the drilling point.

3.6.3 *Gas Discharge*

Where subterranean gases like methane are encountered either with the return water or gas bubbles or as gas shows at specific depths this information should be recorded. Samples of gas should be collected and preferably analyzed at site. Where this is not possible special precautions should be taken to send the samples in hermetically sealed containers for subsequent chemical analysis.

3.6.4 *Permeability Tests*

These tests are necessary for properly evaluating the permeability of strata over which the proposed engineering structure will be founded and to plan seepage control measures. These tests shall be conducted in accordance with IS 5529 (Part 1) and IS 5529 (Part 2).

3.6.5 *Deviation of Inclined Drill Holes*

The deviation survey of all vertical or inclined drill holes of depth more than 60 m if any, during drilling should be recorded in each run by using a bore hole clinometer. This is especially required in over burden cover and also in the geological formation which are characterized by alternating competent/ non-competent layers. In the absence of a bore hole clinometer, measuring of inclination of the hole with the help of etching by hydrofluoric acid of a glass tube lowered suitably in the hole, should be undertaken.

3.7 Other Observations

Details of casings and bits used, depth at which blasting was done, if any, for driving of casing, types of barrel (single, double or triple) and bits, depth at which in situ tests were done, mineralization, if any, encountered, supplies like petrol, diesel, etc, used and other details given in Annex A should also be recorded.

4 RECORD OF OBSERVATIONS

4.1 The observations and other details should be recorded in the pro forma given in Annex A. Suitable notes shall be recorded for special observations.

4.2 One sheet of the pro forma given in Annex A should be used for one shift of drilling only. Drilling observers should be present whole time on the drilling job. Copies of the proforma, duly filled in, should be kept with the cores and may also be sent to the concerned engineering geologist.

4.3 Systematic photographs of the core should be undertaken from top view using a wide angle digital colour camera. Each photographs should indicate the drill hole no., start-end depths and scale for reference. A sample photograph is enclosed as Annex B.

ANNEX A

(*Clauses* 3.6, 3.7, 4.1 *and* 4.2)

A-1 DAILY DRILL REPORT

Project												
Location												
Drilling Machine	i.	Machine No	:		Hole No	:			Date	:		
	ii.	Machine Type	:		Co-ordinates	:			Shift	:	From (h)	To (h)
Feed: Screw/ hydraulic	:				Bearing of hole	:			Collar elevation	:		
Pump	i.	Pump No	:		Angle with horizontal	:			Ground elevation	:		
	ii.	Capacity	:		Depth drilled during the shift	:	From (m)	To (m)	Depth of water level in the hole	:	At start of shift (m):	At end of shift (m):
	iii.	Pressure Used (N/mm^2)	:									

CASING LOWERED			RUN		LENGTH DRILLED (m)	GEAR/ Rpm	RATE OF PENETRATION (mm/minute)	TYPE AND SIZE OF HOLE (mm)	WATER LOSS (*see* Drill observer's remark 1)	COLOUR OF RETURN WATER	SR. NO OF CORE PIECES	SIZE OF CORE PIECES (mm)	CORE RECOVERY		TYPE OF ROCK	REMARKS
Size (mm)	From depth (m)	To depth (m)	From (m)	To (m)									Length (m)	Percentage of Core recovery		

SUPPLIES				BITS USED					
Petrol (1)	Diesel (1)	Motor Oil (1)	Misc	Type and Size	Depth		Old/New with Number	Carat load, and make	Stones per Carat
					From (m)	To (m)			

Drilling and Core Observer   Operator/Drilling   ForemanOffice-in-Charge/Engineering Geologist

A-2 DRILLING OBSERVER'S REMARKS

a) Water loss during drilling may either be recorded as:
    1) complete, when no water is coming out, partial or nil water loss; or
    2) in percentage of return water (100 percent loss when no water is coming back and no water loss or 0 percent when all the drilling water is coming back) (*see* **2.1.2)**.
b) Rate of penetration in special zones (soft or broken zones) (*see* **2.2)** and other details of drilling like heavy vibration and torque *see* **2.4**) recorded during drilling.
c) Reasons for heavy core loss (*see* **2.3)** as integrated with rate of penetration.
d) Any special conditions not recorded, for example, depth at which blasting was done while driving casing, depth at which hole was grouted (*see* **2.6.1)**, artesian water conditions (if any observed) during drilling (*see* **2.6.2)**, gas discharge (*see* **2.6.3**).
e) If water flows are encountered at the collar of the drill, then the pressure head and discharge at the collar should be recorded. On completion of the hole, the pressure decline over a period of time should also be recorded.
f) Other details given at **2.7** should also be observed and recorded.
g) The feel of the driller may be suitably recorded in remarks column.

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